UNIVERSITY OF PENNSYLVANIA

THE APPLICATION OF THE AUDITORY MEMORY SPAN TEST TO TWO THOUSAND INSTITUTIONAL EPILEPTICS: A STUDY IN RELATIVE ASSOCIABILITY.

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A THESIS

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THE APPLICATION OF THE AUDITORY MEMORY SPAN TEST TO TWO THOUSAND INSTITUTIONAL EPILEPTICS; A STUDY IN RELATIVE ASSOCIABILITY.

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INTRODUCTORY

That strange disorder, or more correctly, complex of phenomena called Epilepsy, has the distinction of being, perhaps, the least understood of the entire range of ills to which flesh is heir. With a history extending into the remote past and knowing neither ethnic nor geographic barrier, the malady has defied every effort to unravel its secrets; to-day, not less than hitherto, it remains "the disease of mystery." Of the etiology, the primary etiology, of epilepsy nothing is known; the pathological findings, both gross and microscopic are for the most part contradictory and inconclusive, and it is therefore to the symptomatology as presented through temporary impairment or loss of consciousness, convulsive seizures, and other manifestations, physical and, more especially psychic, that one must look for the diagnosis. The late Dr. Munson, pathologist at the Craig Colony, Sonyea, N. Y., observed, after years spent in the performance of autopsy examinations of epileptics, that he had found neither gross nor microscopical morbidity which could be considered as specific. "Pathology and pathological physiology," another authority points out,[1] "have failed to furnish us with accurate data in the making of a differential diagnosis of the form of epilepsy.....General pathology has been greatly handicapped by the fact that changes occurring in the brain are not sufficiently isolated, or that it is not possible to decide whether we have to do with the cause or the effect of the disease, and..... the most promising study of metabolism suffers from the same insufficiency....." During the last two decades the investigation of epilepsy has undergone a pronounced and rapid evolution. Interest centered, not many years back, in the convulsive phenomena; somewhat later in presumed metabolic de-

[1]Dr. Katzen-Ellenbogen, "The Mental Efficiency in Epileptics," *Epilepsia*, Vol. 3. p. 505.

rangements, and still more recently, in the hypothesis of a psychic causality. What the next stage will be none can say. Much will depend, no doubt, on the results achieved by those students who, at the moment, are attacking the problem from the psychological side. Epileptic psychology, in fact, is a little world in itself, including the mental phenomena which precede, follow the attack, synchronize therewith, or occur during the interparoxysmal period, as well as the more persistent states of amentia, dementia and other chronic modifications of personality. An inexhaustible and fertile field for inquiry thus presents itself to the student of pathological mental behavior. The most outstanding problem here, as perhaps the most important, is the patient's mental and intellectual ability in its quantitative relation to that of the normal individual. Our present undertaking is engaged with this aspect of the subject. That a lessened mental ability is a frequent concomitant of epilepsy is commonly recognized and is fully evidenced by statistical data.[1]

A variety of theories, which we reserve for later discussion, have been put forward to account for this fact. The study herewith presented follows the plan of applying, under conditions as favorable as possible, and to a number of epileptics sufficiently large to insure a scientific result, a simple psychological test, involving a single ability and capable of serving at once as a qualitative and a quantitative measure of intelligence. The Auditory Memory Span Test was chosen as best suited to the purpose in hand.

In the first place, the ability primarily involved in this test is not that of memory as the name would seem to imply, but of association, or, as it has been called, associability, which has been defined as[2] "the number of discrete perception associated in a single act of attention and the combination of the associated component parts of a single perception." "For diagnostic purposes," to quote from Humpstone,[3] "it would be valuable to know just what mental processes are involved in the performance. It has been assumed by almost everybody who has written on the test that it tests memory. A careful analysis causes us to doubt the validity of the assumption. Some imagination is required. The subject must have enough imageability to get perceptions of the stimuli. If auditory im-

[1]Tables, pp. 11-17.

[2]Lightner Witmer.

[3]Henry J. Humpstone, "*Some Aspects of the Memory Span Test: A Study in Associability*," Psychological Clinic Press, Philadelphia, Pa., 1907, p. 15.

ageability, for instance, were entirely wanting there could be no response to the auditory presentation. In no sense can the test measure imageability either as to types employed or the extent to which they are involved in the performance. In the same sense memory is involved. The images must be retained long enough for reproduction. But this period is so brief that the results do not furnish any criterion by which to judge of retentiveness. The single presentation cannot be considered as training. So that the two and the only two, aspects of that particular form of imagination called memory cannot be measured or even estimated from the result of this test." It goes without saying that a certain degree of associability is essential to all intelligent behavior and it is of special value in the development of the intellect. The possession of a memory span of three or less will suffice for only the simplest mental operations, while a memory span of at least five is requisite to the successful prosecution of the ordinary mental activities incident to normal life. For the more involved intellectual processes a correspondingly high memory span is required. It follows then that the Memory Span Test possesses peculiar value as a measure, both qualitative and quantitative, of the ability for intelligent behavior and intellectual endeavor. As a quantitative measure its value varies directly with the chronological age of subnormal subjects, and inversely with that of subjects who are supernormal.

In the second place, the Memory Span Test is especially suited to pathological, and above all, epileptic subjects, who, as a rule, disclose in their mental behavior, wide variations from the normal. It is of service in such cases not merely because of its value as a measure of mental ability, but also by reason of the great simplicity of the test and the ease with which it can be applied. Epileptic subjects are unusually prone to manifestations of nervous unrest and emotional instability,—of distractibility of attention and early fatigue. It is evident, therefore, that, the value of results obtained from the application of psychological tests to these persons varies inversely with the time consumed and the effort imposed upon the subject during the performance. For this reason the more complicated Intelligence Tests (Binet-Simon, etc.) are unsuitable for application in such cases, and, to a lesser degree, the same holds true also of Performance Tests.

The Auditory Memory Span Test is free, furthermore, from certain disadvantages connected with the Intelligence Tests, which are so serious as to disqualify them for use in a study of this type. We refer, in particular, to the emphasis laid upon

language ability, as well as upon other abilities acquired through pedagogical and social training. The Intelligence Tests, in other words, are standardized for normal school-children, and not for normal working-children, or for those who for one reason or another have been denied an adequate education. It is clear, therefore, that such tests can be of little service in determining the mental rating of an eplipetic child. There are other faults inseparable from some of these tests, such as the allowance of credit only for complete success, etc., by reason of which they are unsuited to pathological subjects.

The Auditory Memory Span Test, again, possesses a unique advantage and one of the greatest importance for the examination of epileptic subjects. The very method of its application affords the examiner an exceptional opportunity for gaining and holding the subject's attention while throwing the whole force of his personality toward eliciting a ready and satisfactory response. For which reason this test is to be preferred to the Visual Memory Span Test wherein the attention of the subject is directed upon an inanimate object,—the printed chart,—rather than upon something imbued with life and feeling,—the countenance of the examiner.

Finally, the Auditory Memory Span Test is recommended by the relatively small time limit required for its application, and the opportunity thus afforded for the examination of a correspondingly large number of subjects. The employment of one of the more complicated Intelligence Tests, requiring for its application to a normal individual thirty minutes to an hour on the average,[1] but in the case of an epileptic subject two or three times as long, would be prohibitive for the purposes of this study since the time element would not allow the examination of a sufficient number of cases to yield results of scientific value. It is the purpose of the present investigation to correlate the results obtained from the application of the Auditory Memory Span Test to institutional epileptics with those obtained from its application to normal persons. The work of Humpstone in standardizing the test as applied to the normal individual and furnishing therewith complete statistical data has made this research possible.

It was part of our original purpose to insert a brief history of the test as employed in the examination of epileptics. But in looking over the files of the *Index Medicus* for the past decade or more, we were surprised to find that practically

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[1]Lewis M. Terman, "*The Measurement of Intelligence*," Houghton, Mifflin Co., 1916, p. 129.

nothing had been done in this particular field. Literature relating to epileptic mentality is relatively abundant, especially of recent date; but only a limited portion of this deals with the administration of Intelligence and Performance Tests, and very rarely is even a cursory reference made to the Memory Span Test. This is not difficult to understand when one considers that it is only for a comparatively short time that epilepsy has been regarded as a malady which could be produced by any factor other than an organic lesion in the brain. The conception of a metabolic or psychic etiology is recent. A glance over the literature listed in the files of the *Index Medicus* for the past two decades illustrates very clearly the change that has taken place in the theory of the disease.

METHOD AND PROCEDURE

In formulating a plan of procedure for the prosecution of our study, one of the first problems involved the selection of cases for experimentation. Mention has been made of the fact that Institutional Epileptics often show mental enfeeblement and that not seldom this enfeeblement is very pronounced. The question therefore arose whether discrimination should not be made in the selection of subjects on the basis of their mental ability, and only those be regarded as eligible for examination who had reached a certain level of intelligence. The matter was given due consideration and it was decided that an arbitrary selection of this type would be impracticable for a number of reasons.

In the first place, our investigation is concerned with the mental behavior of Institutional Epileptics as such, and therefore assumes an unselected inductive material. And in the second place, it would be difficult to find a basis of selection that would meet with the approval of all. In any event, the employment of a more or less complicated Intelligence Test could not be avoided, yet such a test, as we have pointed out, is unsuited to the epileptic. Wherefore, our study has proceeded on the basis of absolute non-selection, all epileptics, whether normal, supernormal or subnormal being regarded as equally eligible. To this end and in the general interest of a wide induction the examinations were distributed among four Institutions for Epileptics, of somewhat different character, located in three states, as follows:

1. The Pennsylvania Epileptic Hospital and Colony Farm, Oakbourne, Pa. (56 cases).
2. The New Jersey State Village for Epileptics, Skillman, N. J. (552 cases).
3. The State Institution for Feeble Minded and Epileptic of Eastern Pennsylvania, Spring City, Pa. (262 cases).
4. The Craig Colony, Sonyea, N. Y. (1130 cases).

The individual subjects were chosen alphabetically or according to age. The age limits were fixed at 5 and 50 years. This age-delimitation afforded an opportunity for the study both of those more severe forms of epilepsy developing in infancy and early childhood, and of those which though developing afterward, were of relatively long standing, while it excluded cases that involved a senile deterioration.

Inasmuch as in a large proportion of epileptic cases the disease does not manifest itself until puberty or even later, it follows that the average chronological age of the subjects available for this study was considerably higher than that of Humpstone, whose investigations were confined to normal individuals, and to school children in particular. The cases examined were found to be almost equally divided between the two sexes, although no attempt at a selection on that basis was made. Following Humpstone's precedent the examinations were limited to white persons. While the exact type of epilepsy was not recorded in every instance, this was done in a large proportion of the cases, and all such were found, without exception to be idiopathic. No patient was accepted for examination concerning whom there existed any doubt as to the diagnosis of the disease. The tests were conducted only during the morning, and the early portion, so far as possible, of the afternoon. This was done to avoid fatigue on the part of the subject. In accordance with the principle that the value of the findings obtained from a test is in direct proportion to the number of persons examined, effort was made to insure a scientific result of authentic worth by giving to the induction a sufficiently broad numerical basis (2,000 cases).

Any psychological test however simple, when applied to epileptics, should be conducted with unusual painstaking, for the subject requires of his examiner very close attention. The time and energy expenditure for applying a test to such persons is, therefore, prohibitive of the examination of as large numbers as in the case of normal individuals who may be tested in groups. This, however, is compensated for, in part at least, by the greater accuracy of the results due to the added care and attention during the examination.

In applying the test, Humpstone's method was followed as closely as possible to avoid any source of error in the correlating of our results with his. But it is obvious that no method is equally applicable to all classes of subjects; diverse groups, as dissimilar individuals, require each a particular mode of approach. Since the subjects of our own investigation were pathological as contrasted with those of Humpstone, most of whom were normal, it was found prudent to diverge at several minor points from his procedure. Where he, for instance, applied the test to groups and asked for a written reproduction, we applied it to individuals, and requested an oral reproduction. Other slight differences will be referred to as we proceed. The following represents our method of examination:

The subject was conducted into a room where he was alone with the experimenter and an attending nurse, the examiner

and the subject taking seats opposite each other, with the nurse sitting at one side. The patient's name and age having been obtained, he was engaged in a brief conversation relating to any matter in which he might be interested, his work, play, family, etc., in order that a satisfactory "rapport" for the test might be established. When his attention had been secured and his interest sufficiently aroused, instructions were given to him as follows: Now listen, I am going to say over three[1] numbers and after I am through I want you to say them exactly as I do. Listen closely and get them just right— 5 - 8 - 3. The digits were pronounced at the rate of one per second, care being taken to avoid rhythm or significant changes in the tone of the voice that might induce a process of grouping of digits on the part of the subject. As a means of indicating to the subject the termination of a series the last digit was given a lower intonation. The construction of the various series was arranged so as to avoid the occurrence of two digits in either the natural or reverse order, the beginning of successive series with the same digit, the repetition of digits except in the series of ten or more, and the employment of zero. Two series each of 3, 4, 5, 6, 7, 8, 9 and 10 digits were used. Because of the pathological character of the subjects, it was deemed best to start the examination, in each case, with the lowest series of digits, i. e. three. If the subject failed to reproduce this series correctly, a second series containing the same number of digits was given him, and lack of success in this series was counted a failure for the entire group. In case the subject was successful with the three digit series, series of greater length were offered him, in order, until the limit for correct reproduction was reached.

The Memory Span was considered to be the highest number of digits that the individual was able to reproduce correctly as given in one of two trials.

[1]The number in each case accorded with the number of digits pronounced.

EXPLANATION AND INTERPRETATION OF THE TABLES AND DIAGRAMS

Table I is self-explanatory. The material presented therein will be discussed in connection with that of other Tables.

Tables II and III are of special interest, because of the higher mental rating of the boys over the girls. While the difference—.3 in the average mean of their Memory Span—is not very great, to this extent the results differ from those of normal individuals, in which the two sexes grade equally. A possible explanation of the disparity, is that in the case of the girls, the period of puberty, because of the establishment of the menstrual function, exercises a more adverse effect upon the disease, and, indirectly, upon the mental organism.

In Table IV is exhibited the Memory Span of epileptic children of both sexes. The mean shows a gradual increase from ages 7 to 18, corresponding, in general, to that of normal individuals, though it is more irregular. The irregularity, however, is not very marked, and has little significance, we believe, in view of the relatively small number of cases included in each age group. The mean for no age under 13 years is as high as three, which, according to the standard for the normal person relegates these children to the feebleminded class, the degree of the mental impairment varying directly with the chronological age of the subject. The highest mean for epileptic children is less than four, which is equivalent to that of a normal individual of five years. The average mean for epileptic children is three, which is approximately half that of normal children, and places them just outside the feebleminded category. A more detailed analysis of this Table reveals the fact that of these children, 36% are distinctly feebleminded, one-half the total number have a mental age of four or less; 68% have a mental age of less than seven, and but 18% have a mental age of more than nine.

Tables VI and VII do not exhibit the same difference in the mentality of the two sexes as was shown in the case of the children. There is a disparity of .1 in the average mean in favor of the male, but this is too slight to be of significance.

In Table VIII we see a fairly regular mean throughout, with a small increase toward the higher ages. The average mean is 4.2 or approximately one-half that of the normal adult. This mean, however, is 1.2 higher than that of the epileptic child. In only a few instances did the mean of the adult fall below the highest mean attained by the child. A

further analysis of the table shows that 14% of the subjects are distinctly feebleminded; 23% have a mental age of four or less; one-half the total number have a mental age of less than seven, and but 23% have a mental age of more than nine.

What inferences are to be drawn from the data here presented? In the first place, it is evident that the epileptic, whether child or adult, has a Memory Span, or, in other words, an associability that approximates but one-half that of the normal individual. A considerable proportion of the epileptics belong to the feebleminded group, and but one-fifth of the total number are capable of any save the simplest mental activity. Of this latter group furthermore, only a few are qualified for the higher intellectual pursuits. Secondly, the epileptic adult shows, relatively, a far higher degree of associability, than the epileptic child, and possesses, therefore, a much greater capacity for mental endeavor. Moreover, he rates higher mentally in relation to the normal individual than does the epileptic child. This difference in relative mental ability of adult and child, increases slowly but directly with the age of the former. It will be observed that these facts are not in accord with the traditional and all but universally accepted theory of mental deterioration in epilepsy.

Tables corresponding to those which we have described, and which form the basis of Humpstone's standardization of the Auditory Memory Span test, will be found in the Appendix. By referring to these Tables comparison can be made between epileptic and normal mental ability, in so far as determined by the above test.

Tables and Diagrams

Table I. Memory Span of Epileptics For Different Ages by Quintiles

Age	No. of Cases	Mean	M. V.	Minimum	Lowest Quintile	Lower Quintile	Median	Upper Quintile	Highest Quintile	Maximum
6	2	3.5	.50	3	3	3	3	4	4	4
7	12	.6	1.08	0	0	0	0	0	0	7
8	15	1.9	2.06	0	0	0	0	3	5	6
9	25	1.5	1.88	0	0	0	0	3	4	6
10	29	2.2	2.01	0	0	0	3	3	4	6
11	35	2.4	2.13	0	0	0	3	4	4	7
12	42	2.6	2.17	0	0	3	3	4	5	8
13	54	3.4	2.13	0	0	3	4	4	6	8
14	59	3.4	2.13	0	0	3	4	5	5	9
15	69	3.0	2.22	0	0	3	4	4	5	9
16	78	3.3	2.26	0	0	3	4	4	6	9
17	58	3.1	2.34	0	0	3	4	4	6	7
18	65	3.9	1.79	0	0	4	4	5	6	8
19	57	4.2	1.74	0	3	4	5	5	6	11
20	61	3.4	2.05	0	0	4	4	5	5	7
21	59	4.4	1.51	0	3	4	5	5	6	8
22	81	3.8	1.74	0	0	4	4	5	5	10
23	67	3.9	1.63	0	3	4	4	5	6	8
24	69	4.1	1.62	0	3	4	5	5	6	9
25	63	4.3	1.53	0	3	4	5	5	6	8
26	50	4.2	1.50	0	3	4	5	5	6	8
27	57	4.4	1.65	0	3	5	5	5	6	8
28	43	4.8	1.32	0	4	4	5	5	6	9
29	53	3.9	1.59	0	3	4	4	5	5	8
30	61	3.9	1.77	0	0	4	4	5	6	9
31	43	3.6	1.77	0	0	4	4	4	5	9
32	61	4.0	1.20	0	4	4	4	5	5	8
33	48	4.3	1.18	0	3	4	4	4	5	9
34	46	4.3	1.57	0	3	4	4	5	6	8
35	46	4.1	1.33	0	3	4	4	5	6	7
36	44	4.0	1.50	0	3	4	4	5	5	8
37	37	4.5	1.66	0	3	5	5	5	6	9
38	37	4.2	1.50	0	3	4	4	5	6	8
39	41	4.2	1.44	0	3	4	5	5	6	8
40	44	4.4	1.34	0	4	4	5	5	6	8
41	26	3.6	1.41	0	3	4	4	4	5	6
42	36	4.9	.93	0	4	5	5	5	6	9
43	37	4.0	1.49	0	3	4	4	5	6	6
44	30	4.1	1.73	0	3	4	5	5	6	8
45	28	4.8	1.11	0	3	5	5	5	6	8
46	27	4.7	.93	0	4	5	5	5	6	7
47	32	4.9	.84	3	4	5	5	5	6	7
48	37	4.9	1.08	0	4	5	5	5	6	7
49	18	5.9	1.07	4	5	5	6	6	7	8
50	13	5.2	1.32	0	4	5	5	6	7	9

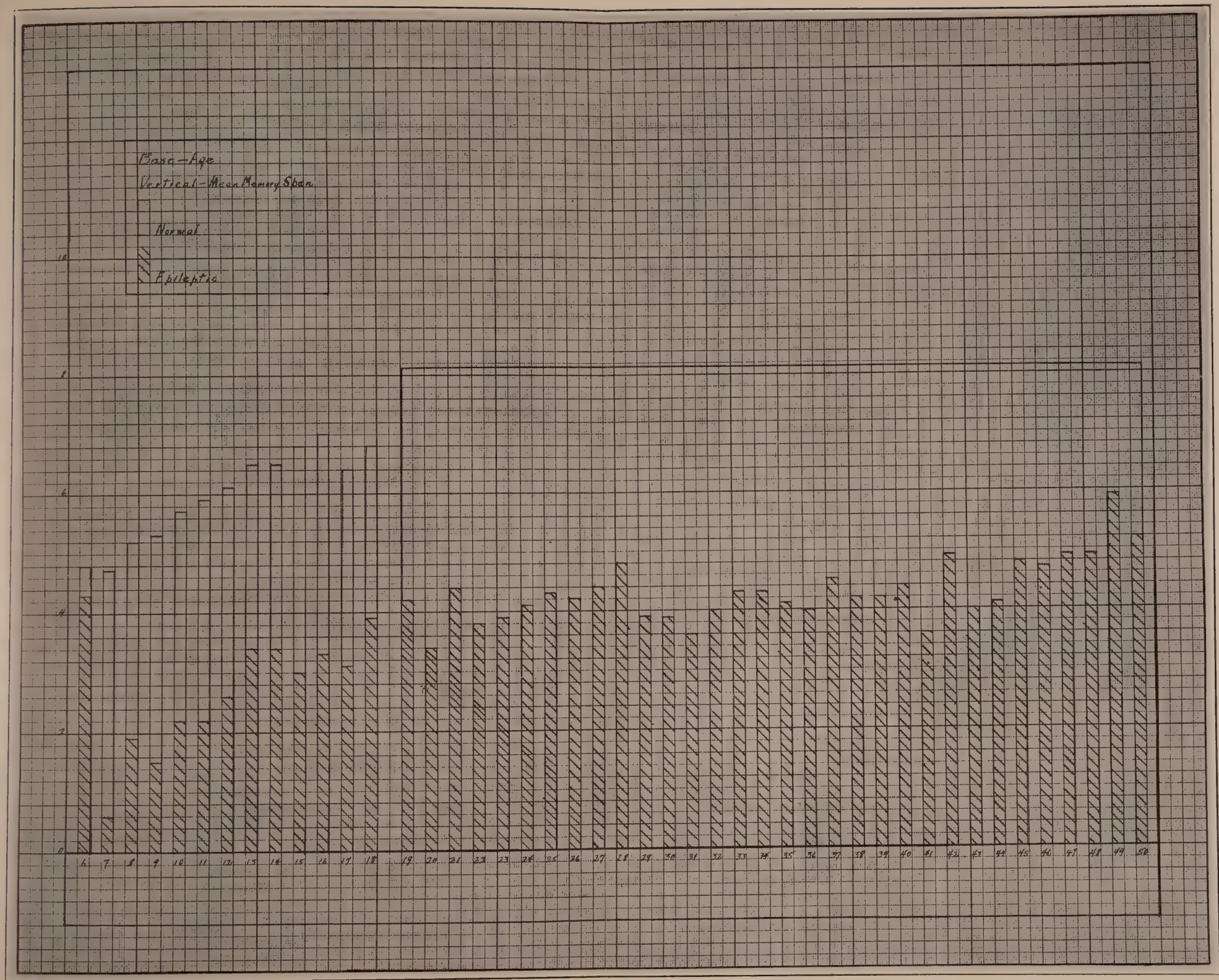

Chart No. 1. To accompany Tables Nos. I, and I (Appendix)

Table II. Distribution of Results From Epileptic Boys

Age	No. of Cases	0	3	4	5	6	7	8	9	Mean	Mode	Median	M. V.
6	1		1										
7	5	4					1			1.4	0	0	2.24
8	5	2		1	1	1				3.0	0	4	2.40
9	16	7	4	3	1	1				2.2	0	3	1.91
10	14	7	3	3	1					1.9	0	3	1.71
11	14	6	1	5	1		1			2.5	0	4	1.68
12	25	10	4	6	2	2		1		2.6	0	3	2.12
13	27	6	5	5	5	3	3			3.7	0	4	1.87
14	35	9	5	6	8	5		1	1	3.6	0	4	2.02
15	38	12	3	8	6	5	2	1	1	3.5	0	4	2.26
16	44	14	9	5	10	4	1	1		3.1	0	3	2.00
17	36	12	4	5	8	4	3			3.3	0	4	2.22
18	34	9	3	5	8	5	3	1		3.8	0	5	2.12
T'ls	294	98	42	52	51	30	14	5	2	3.1	0	4	2.14

Table III. Distribution of Results From Epileptic Girls

Age	No. of Cases	0	3	4	5	6	7	8	9	Mean	Mode	Median	M. V.
6	1			1									
7	7	7											
8	10	6	2	2						1.4	0	0	1.68
9	9	8	1							.4	0	0	.76
10	15	6	3	2	2	2				2.6	0	3	2.08
11	21	11	3	4	1	2				2.0	0	3	2.09
12	17	7	2	4	2	1		1		2.7	0	3	2.35
13	27	10	2	6	3	5		1		3.1	0	4	2.28
14	24	7	3	5	6	3				3.2	0	4	1.80
15	31	13	5	6	4	2	1			2.5	0	3	2.11
16	34	10	3	8	2	7	2	1	1	3.6	0	4	2.27
17	22	10	1	4	2	3	2			2.8	0	4	2.79
18	31	5	2	12	4	6	2			4.0	4	4	1.42
T'ls	249	100	27	54	26	31	7	3	1	2.8	0	3	2.22

Table IV. Table II and Table III Combined

Age	No. of Cases	0	3	4	5	6	7	8	9	Mean	Mode	Median	M. V.
6	2		1	1						3.5			.50
7	12	11					1			.6	0	0	1.08
8	15	8	2	3	1	1				1.9	0	0	2.06
9	25	15	5	3	1	1				1.5	0	0	1.82
10	29	13	6	5	3	2				2.2	0	3	2.01
11	35	17	4	9	2	2	1			2.2	0	3	2.14
12	42	17	6	10	4	3		2		2.7	0	3	2.15
13	54	16	7	11	8	8	3	1		3.4	0	4	2.09
14	59	16	8	11	14	8		1	1	3.4	0	4	1.99
15	69	25	8	14	10	7	3	1	1	3.0	0	4	2.22
16	78	24	12	13	12	11	3	2	1	3.3	0	4	2.16
17	58	22	5	9	10	7	5			3.1	0	4	2.34
18	65	14	5	17	12	11	5	1		3.9	4	4	1.79
T'ls	543	198	69	106	77	61	21	8	3	3.0	0	4	2.17

Table V. Aggregate of Results of Tables II, III and IV

	No. of Cases	0	3	4	5	6	7	8	9	Mean	Mode	Median	M. V
Male	294	98	42	52	51	30	14	5	2	3.1	0	4	2.14
Female	249	100	27	54	26	31	7	3	1	2.8	0	3	2.22
Totals	543	198	69	106	77	61	21	8	3	3.0	0	4	2.17

Table VI. Distribution of Results From Adult Male Epileptics

Age	No. of Cases	0	3	4	5	6	7	8	9	10	11	Mean	Mode	Median	M. V.
19	40	7	5	9	8	7	2	2				4.1	4	4	1.73
20	37	10	4	6	12	4	1					3.4	5	4	1.96
21	36	6	1	7	12	6	2	2				4.4	5	5	1.66
22	41	12	4	13	6	4	1	1				3.2	4	4	1.97
23	44	6	5	15	11	4	2	1				4.0	4	4	1.30
24	32	4	3	10	8	1	3	1	2			4.4	4	4	1.65
25	24	6	3	5	5	2	2	1				3.7	0	4	1.99
26	24	6	1	7	5	4	1					3.6	4	4	1.87
27	34	4	6	4	10	6	1	3				4.4	5	5	1.66
28	24	1	1	7	8	3	2	1	1			4.3	5	5	1.60
29	29	4	7	4	10	1	3					3.9	5	4	1.44
30	35	7	2	9	10	4	2		1			4.0	5	4	1.70
31	23	5	2	7	4	3		1	1			3.9	4	4	1.82
32	30	4		11	8	4	2	1				4.3	4	4	1.40
33	22	3	4	8	3	1	1	1	1			4.0	4	4	1.50
34	22	3	2	5	5	4	1	2				4.5	4	5	1.68
35	22	2	3	7	6	4						4.1	4	4	1.15
36	18	2		7	4	2	2	1				4.6	4	5	1.44
37	21	2	1	1	7	7	1	1	1			5.1	5	5	1.39
38	20	2	2	7	3	2	2	2				4.6	4	4	1.61
39	14	3		2	4	1	3	1				4.5	5	5	2.07
40	21		2	4	6	7	1	1				5.2	6	5	.98
41	9	2		4	2	1						3.6	4	4	1.56
42	22	1	3	3	10	4			1			5.6	5	5	1.21
43	15	3	3	1	6	2						3.7	5	5	1.73
44	16	1	1	3	5	4	1	1				4.9	5	5	1.22
45	12	1	3		4	3		1				4.6	5	5	1.55
46	10			1	7		2					5.3	5	5	.68
47	14		1	2	5	4	2					5.1	5	5	.87
48	19			7	4	7	1					5.1	6	5	.86
49	9			1	2	3	1	2				6.1	6	6	1.03
50	8	1		1	3	3						4.6	5	5	2.22
T'ls	747	108	69	178	203	112	42	27	8			4.3	5	5	1.59

Table VII. Distribution of Results From Adult Female Epileptics.

Age	No. of Cases	0	3	4	5	6	7	8	9	10	11	Mean	Mode	Median	M. V.
19	17	3		3	8	2					1	4.4	5	5	1.71
20	24	8	2	5	3	5	1					3.3	4	4	2.20
21	23	1	6	7	4	3	1	1				4.3	4	4	1.24
22	40	5	6	9	11	5	2	1		1		4.3	5	4	1.58
23	23	7	1	4	4	6	1					3.6	0	4	2.21
24	37	7	4	5	14	7						3.9	5	5	1.66
25	39	3	2	8	19	3	2	2				4.6	5	5	1.18
26	26	1	4	6	9	2	3	1				4.7	5	5	1.20
27	23	3	4	1	9	4	2					4.3	5	5	1.60
28	19	1	4	6	3	2	2	1				4.5	4	4	1.39
29	24	5		10	4	2	2	1				3.9	4	4	1.64
30	26	6	2	5	7	5	1					3.8	5	4	1.85
31	20	5	2	6	7							3.3	5	4	1.65
32	31	4	3	14	8	2						3.8	4	4	.98
33	26		3	10	9	3	1					4.6	4	4	.81
34	24	3	2	8	6	3		2				4.3	4	4	1.44
35	24	4	1	8	5	4	2					4.1	4	4	1.51
36	26	5	5	6	7	2		1				3.6	5	4	1.63
37	16	3	2	6	2	2	1					3.7	4	4	1.55
38	17	3	2	4	6	2						3.8	5	4	1.49
39	27	3	3	9	4	6	1	1				4.3	4	4	1.42
40	23	3	1	8	4	5	2					4.3	4	4	1.45
41	17	3	1	9	2	2						3.6	4	4	1.33
42	14			4	6	3		1				5.1	5	5	.76
43	22	3	1	8	3	7						4.2	4	4	1.38
44	14	4	3	2	3	1	1					3.2	0	4	1.93
45	16		2	3	6	5						4.9	5	5	.79
46	17	1	1	7	5	2	1					4.4	4	5	1.02
47	18		2	7	6	3						4.5	4	5	.78
48	18	2		5	5	4	2					4.6	5	5	1.39
49	9			2	3	1	2	1				5.7	5	5	1.19
50	5			1	1	1	1		1			6.2	6	6	1.44
T'ls	705	96	69	196	193	104	31	13	1	1	1	4.2	4	4	1.44

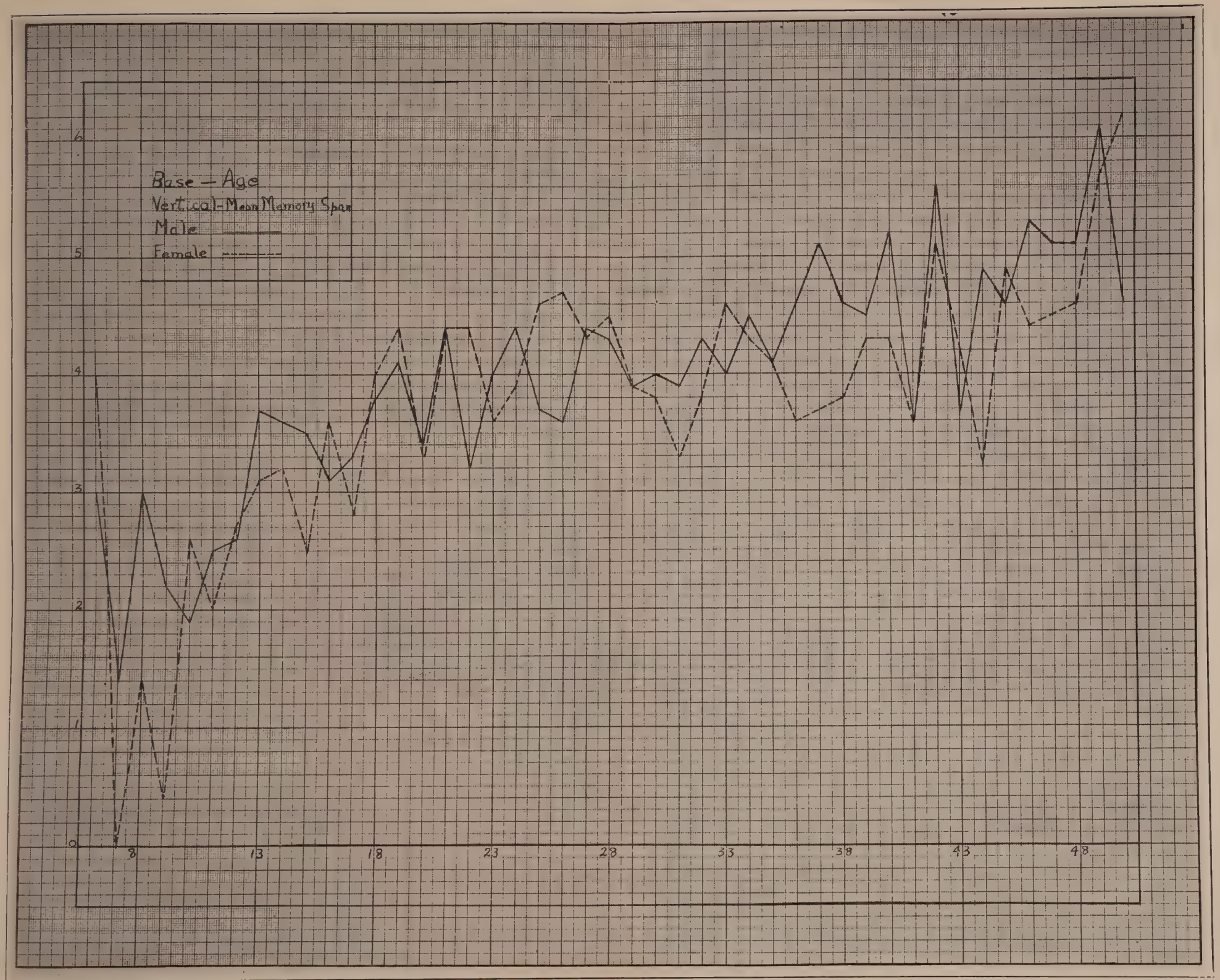

Chart No. 2. To accompany Tables Nos. II, III, VI, and VII

Table VIII. Table VI and Table VII Combined

Age	No. of Cases	0	3	4	5	6	7	8	9	10	11	Mean	Mode	Median	M. V.
19	57	10	5	12	16	9	2	2			1	4.2	5	5	1.74
20	61	18	6	11	15	9	2					3.4	0	4	2.05
21	59	7	7	14	16	9	3	3				4.4	5	5	1.51
22	81	17	10	22	17	9	3	2		1		3.8	4	4	1.74
23	67	13	6	19	15	10	3	1				3.9	4	4	1.63
24	69	11	7	15	22	8	3	1	2			4.1	5	5	1.62
25	63	9	5	13	24	5	4	3				4.3	5	5	1.53
26	50	7	5	13	14	6	4	1				4.2	5	5	1.50
27	57	7	10	5	19	10	3	3				4.4	5	5	1.65
28	43	2	5	13	11	5	4	2	1			4.8	4	5	1.32
29	53	9	7	14	14	3	5	1				3.9	4	4	1.59
30	61	13	4	14	17	9	3		1			3.9	5	4	1.77
31	43	10	4	13	11	3		1	1			3.6	4	4	1.77
32	61	8	3	25	16	6	2	1				4.0	4	4	1.20
33	48	3	7	18	12	4	2	1	1			4.3	4	4	1.18
34	46	6	4	13	11	7	1	4				4.3	4	4	1.57
35	46	6	4	15	11	8	2					4.1	4	4	1.33
36	44	7	5	13	11	4	2	2				4.0	4	4	1.50
37	37	5	3	7	9	9	2	1	1			4.5	5	5	1.66
38	37	5	4	11	9	4	2	2				4.2	4	4	1.50
39	41	6	3	11	8	7	4	2				4.2	4	5	1.44
40	44	3	3	12	10	12	3	1				4.4	5	5	1.34
41	26	5	1	13	4	3						3.6	4	4	1.41
42	36	1	3	7	16	7		1	1			4.9	5	5	.93
43	37	6	4	9	9	9						4.0	4	4	1.49
44	30	5	4	5	8	5	2	1				4.1	5	5	1.73
45	28	1	5	3	10	8		1				4.8	5	5	1.11
46	27	1	1	8	12	2	3					4.7	5	5	.93
47	32		3	9	11	7	2					4.9	5	5	.84
48	37	2		12	9	11	3					4.9	4	5	1.08
49	18			3	5	4	3	3				5.9	5	6	1.07
50	13	1		2	4	4	1					5.2	5	5	1.32
T'ls	1452	204	138	374	396	216	73	40	9	1	1	4.2	5	5	1.53

Table IX. Aggregate of Tables VI, VII and VIII

	No. of Cases	0	3	4	5	6	7	8	9	10	11	Mean	Mode	Median	M. V.
Male	747	108	69	178	203	112	42	27	8			4.3	5	5	1.59
Female	705	96	69	196	193	104	31	13	1	1	1	4.2	4	4	1.44
Totals	1452	204	138	374	396	216	73	40	9	1	1	4.2	5	5	1.53

GENERAL DISCUSSION AND INTERPRETATION

The inference adverted to a moment ago, that epilepsy does not necessarily imply a deterioration of the mind, is reenforced by a number of further considerations. We have called attention to the fact, commonly recognized by authorities, that mental impairment is a frequent concomitant of epilepsy. Three explanations are possible:

1. Epilepsy produces mental enfeeblement.
2. Mental enfeeblement produces epilepsy.
3. Epilepsy and mental enfeeblement are the result of:
   (a) Distinct etiological factors which act either in unison or independently of each other.
   (b) A common factor.

We will consider these explanations in turn:

1. Epilepsy produces mental enfeeblement.

This theory is commonly accepted today by both the laity and the medical profession. The conviction has become deeply rooted that epilepsy is always accompanied by a mental weakening, gradual as a rule, though rapid in some cases. This deterioration is attributed to occult changes in the cerebral cortex presumably induced by the disease. But the question arises, how, on this hypothesis, is one to account for those cases of epilepsy which indicate either no changes in the brain, or changes that are insignificant? We are not referring in this connection, to the idiot savant who by reason of extraordinary manual dexterity and sensory acuteness is able to accomplish on the piano or violin amazing performances. Musical proficiency of this type is not, of itself, an indication of intelligence. We refer, rather, to the individual who is "eccentric"—who differs from his fellows,—who is more capable of creation,—is better able to face unexpected difficulties, novel situations, new problems, and to devise, rapidly, solutions that shall prove adequate. These are criteria which mark the person of "superior intelligence." Allied thereto is the other class of "superior intellectual ability,"—those who, having a wide knowledge, possess the capacity for using it, whose mental power is equal to the finer discriminations and the more in-

volved syntheses. Such persons, though not commonly met with in institutions for the epileptic, are too abundant to be regarded as exceptions. Our personal acquaintance has included cases of this type; others we have learned of through inquiries made of epileptologists. The literature cites interesting instances of like import—epileptics, of superior, in some cases of highly superior, intelligence; more than one writer calls attention to the fact that these occurrences are much more common than is generally supposed.

[1]"Mental failure need not be the necessary result of epilepsy, as in rare instances the affection has been observed not to be incompatible with retention of all the normal mental faculties."

[2]"There are types of epilepsy that destroy all the faculties of the mind within a very short while. There are other types, of frequent expression, that leave the mind but little impaired, even if the epilepsy exists from infancy to the end of the ordinary span of life."

[3]"One of the best wood carvers that I have ever known, a man who did original work for the big architects," (an index not of mere manual dexterity but of true intelligence) "supporting a wife and three children, was an epileptic from boyhood. Another had attained the position of Governor of the State. Another held an important legal position in a great city,—was a prominent lawyer carrying difficult cases to successful issues" (a further index of intelligence). "Another a clergyman of powerful intellect and convincing eloquence. Another a voluminous author, with some of his books translated into foreign tongues; while one of the worst examples I ever knew—a man who in fifty years had had 28,000 convulsions—managed his own ample estate and his home with prudence. It would be possible, we imagine, for each of us to select from our own case books, especially if we followed our patients into their private lives—illustrations just as interesting, and if not for the misery-producing bias against fits, to give names of people who in spite of epilepsy were efficient in various vocations."

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[1]N. S. Yawger, "The Mental Manifestations of Epilepsy," *J. Abnor. Psychol.*, Bost., 1912-12. 7, p. 428.

[2]William P. Spratling, "Guides to the Prognosis in Epilepsy, with Remarks on the Curability of the Disease; Including Reports of Thirty-four Cases," *New York Medical Journal and Philaedelphia Medical Journal, Consolidated*, April 9 and 16, p. 737.

[3]Matthew Woods, "In Spite of Epilepsy," *Transactions of the National Association for the Study of Epilepsy and the Care and Treatment of Epileptics*, Vol. 6, 1908, p. 47.

[1]"From time to time I have seen epileptics well advanced in years who have had this disorder since early childhood and who nevertheless had acquired a University Degree, standing well in their classes during their college work."

How is this class of cases to be explained on the assumption that epilepsy induces mental enfeeblement? Various hypotheses have been suggested, namely, that such cases represent an exceptionally mild form of the disease, that the incidence of the pathological conditions must have occurred so late in life that the brain was not injured during its developmental period, that the malady had too short a duration for its effect on the brain to become manifest, that the diagnosis was mistaken. We find it stated,[2] for instance, that there have been "a few cases who have had convulsions for years, and who, at the time of death have shown practically no mental impairment; these cases usually had a late onset, the convulsions were rather infrequent, and the cases are relatively few." Another authority[3] declares: "It is obvious therefore in a given case of epilepsy which shows none of the makeup of the epileptic constitution and no physical or mental deterioration from this malady, that one should consider such a case with the greatest care in the light of our knowledge of affect epilepsy or a psychogenic convulsant in a neuropath."

Etiological interpretations of this character may or may not be valid with respect to certain geniuses of the past—Caesar, Mohammed, Napoleon, and others, who, according to the testimony of historians were epileptics. The extant evidence is far too scanty and unreliable, in the opinion of most contemporary writers, to admit of a positive diagnosis, the thread of evidence being still more tenuous in the detailed expositions now and again essayed. "None of them," i. e. alleged epileptic geniuses, says Spratling[4] "had essential epilepsy in early life, as far as history goes to show; they all developed it late in life in comparatively mild forms,—in forms not incompatible with the highest intellectual endowment; ....."

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[1]William T. Shanahan, "*Hygiene of the Epileptic School Child*," Craig Colony Press, Sonyea, N. Y., p. 7.

[2]D. A. Thom, and E. S. Bundy, "Epileptic Dementia," *Bull. Mass. Comm. Ment. Dis.*, 1918-19, Vol. II., No. 2, p. 52.

[3]L. Pierce Clark, "A Clinical Contribution to the Diagnosis of Epilepsy." *Transactions of the National Association for the Study of Epilepsy and the Care and Treatment of Epileptics*, 1914, p. 82.

[4]William P. Spratling, "*Epilepsy and its Treatment*," W. B. Saunders & Co., 1904, p. 470.

Dercum[1] goes even further: "Doubt may..... properly be entertained as to the accuracy of statements to the effect that epilepsy may not only be unattended by deterioration but may even exist in persons of unusual or phenomenal mental endowment, thus both Caesar and Napoleon are commonly spoken of as epileptics and yet the suspicion that the attacks from which they suffered are really hysteric is not without justification." Yawger[2] is not less emphatic: "Some writers have endeavored to establish a relationship between genius and epilepsy based upon the statement that a number of great men have had or were alleged to have had this disease. Among those cited are Mohammed, Caesar, St. Paul, Mozart, Richelieu, Swift, Swedenborg and Napoleon; we have no good reason for believing that most of these men had epilepsy, and there probably is no such relationship."

These and kindred types of explanation, however, would not apply to the instances of normal or supernormal mentality that have either fallen under our personal observation or of which we have learned through the epileptologists, since in all these cases the incidence of the disease occurred early in life, the attacks were both frequent and severe, the malady was of relatively long standing, and the diagnosis was that of skilled expert opinion.

The view has been put forth that such cases do not represent epilepsy at all, but are given this designation through a mistaken conception of the term; in lieu of epilepsy we have a symptom complex complete in every respect save the single element of mental enfeeblement. The question thus resolves itself into a mere matter of connotation: after all, however, it is not names but facts with which we are concerned. Even though an exceptionless concomitance between epilepsy and impairment of the mind were established, this would fail to demonstrate a causal nexus, though it might imply it. But as we have seen, such a concomitance does not exist.

Finally, it must be remembered that dementia is a frequent concomitant of amentia (the term is intended here to refer to all cases of inherent subnormal mentality regardless of the degree); a mind, in other words, below normal shows a tendency to a more rapid decline than does one which is normal or supernormal. In determining whether epilepsy is

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[1]Francis K. Dercum, "*A Clinical Manual of Mental Diseases*," W. B. Saunders & Co., 1917, p. 250.

[2]N. S. Yawger, "The Mental Manifestations of Epilepsy," *J. Abnor. Psychol.*, Bost., 1912-13, 7. p. 421.

responsible for mental deterioration this fact should always be borne in mind. That is to say, in cases where epilepsy represents one member of a triad, amentia and dementia being the other correlates, the epilepsy might remain etiologically passive, for all we know, but the amentia hardly so.

The second hypothesis, that mental enfeeblement produces epilepsy, as the contrary theory that epilepsy causes an impairment of the mind, would appear untenable, and for a like reason. Mental weakness may, indeed, and, no doubt, often does, yield a favorable site for subsequent epileptic disease.[1] "It is generally recognized that the feebleminded have a tendency to convulse. Among the aments of England, Tredgold found that 36% of the feebleminded, 40% of imbeciles, and 50% of idiots were liable to become epileptic sometime during life." But that this is not necessarily the case is proven by the vast multitude of feebleminded folk who are non-epileptic.

Setting aside, as inadequate in the light of observed fact, the first two theories, which derive either epilepsy or feeblemindedness the one from the other (some have even found in the latter an essential constituent of the epileptic state), we are left with the third, namely, that the two pathologies are the effect of:

1. Distinct etiological factors, acting together or independently.
2. A common factor.

This third hypothesis is not arrived at merely by a process of elimination; there are noteworthy facts that in our judgment lend positive support to it. Moreover, while the mentally impaired and the epileptic may both be victims of the same etiology, and in some instances probably are, we feel that this is not necessarily the case, and that either malady often stands, so to speak, on its own causal foundation. A glance at the study of the disease, as hitherto carried on, will throw no little light, we have reason to believe, upon this question.

It is assumed by most of the authorities that a primary cause, which acts in or through the cerebral cortex, lies at the root of epilepsy, though, as has been stated, this awaits demonstration. By reason of the fact that the assumption has not yet proved amenable to methods of research, investigators have been thrown back upon a study of the secondary, or as

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[1] "Nineteen Epileptic Families: A Study," *State of New York, State Board of Charities, Eugenics and Social Welfare Bulletin*, No. 9, 1917, p. 10.

we prefer to call them, extraneous factors. The concentrating of attention upon these contributory sources of the disease, and the effects induced through them, has led to that pathological association of epilepsy with feeblemindedness to which allusion has been made. The reasons for this are not far to seek. Most of the data relating to epilepsy have been obtained from institutional cases. These subjects are readily available for study, and can be examined with relative convenience and dispatch, whereas access to the homes of private patients is often difficult, and because scattered over a wider area, the investigation of an equal number of such cases would require a greater expenditure of time and effort. Institutional are differentiated from other cases, however—and this is germane to our thesis—by two facts. Relatively they are a small group. But 3½% of the epileptics of the United States are to be found in any institution. And secondly, they present certain characteristics as a rule, certain qualitative differentiae, which mark them off as a type. It is well known that institutional patients represent the less fortunate strata of society, that they come from social surroundings and from stocks which exhibit variant forms of subnormality in general and a lack of power to measure up to the social criterion. In the ancestry is frequently found alcoholism, sexual perversion, and devasting forms of physical and mental disease. These baneful heredital effects are generally accentuated by environmental conditions which conduce to the perpetrating of offences against body and mind, and disclose an absence of those hygenic, educational and social advantages that would tend to act as a corrective. The result is a site especially favorable for both epilepsy and feeblemindedness.

Investigations carried out by Dr. Cleaves[1] at the Monson State Hospital, Massachusetts, brought to light findings that could doubtless be paralleled at other institutions. A summary of her report is as follows:

"Nationality. Of the epileptics who are under institutional care in Monson State Hospital, 40.7% are of American parentage using the word 'American' to indicate those born in America of parents who were likewise of American birth. There are 13.3% who are of mixed American and European parentage, and 46% are of foreign parentage. Education. The number of illiterate, dependent and feebleminded is large, as would be expected by any who are familiar with the mental

[1]Helen Taft Cleaves, "A Study of the Nationality, Education, Occupation, Religion and Civil Condition of 1000 Epileptic Patients at Monson State Hospital," *Bull. Mass. Comm. Ment. Dis.*, Bost., 1918-19, 2, pp. 80-84.

deterioration caused by epilepsy.[1] Over half, 59% developed epilepsy before the age of twelve. This means mental enfeeblement, to a greater or less degree, for all that number; idiocy, usually, when the onset occurred before the third year of life, more or less stunted development, varying from idiocy to moron type when it occurred between three and twelve years. There are 28%, or more than one-fourth of this entire group, who are incapable of any education, many being incapable of speech even; 26% can read and write only, the reading being confined to the simplest words, the writing being often little more than the ability to sign the name. Adding this gives 54%, who are practically illiterate. Of the remainder 42% have a common school education. I have put under this heading all those who have attended school beyond the Fourth Grade, which is a very liberal interpretation of the term, you will concede, putting, however, those who have attended High School in another list. Of these there are 3%, about half the number having been graduated Four in the 1000 patients have attended college, taking work toward an A.B. degree, two having obtained that degree. Four others have attended business college. Occupation. One-half, or 50% of the entire number have never been self-supporting, and but few of those who have supported themselves have done work calling for a high degree of skill or ability..... There are, of course, epileptics in the professions; some of them are conducting business successfully, others occupy positions of great responsibility. But the number is small, and these do not dement rapidly, and such cases seldom come to institutional care.[2] Civil Condition. Of the 30% who had reached marriageable age before the onset of epilepsy, many were primarily feeble-minded, epilepsy being grafted on this condition of mental enfeeblement."[3]

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[1]It will be observed that Dr. Cleaves, in accord with the precedent of other authorities, finds epilepsy etiologically responsible for mental deterioration.

[2]Illustrating our contention that the institutional cases represent a selected group and in no sense constitute a pattern of the epileptic section of the populace as a whole.

[3]If we interpret Dr. Cleave's language correcty, she derives the two maladies, as represented in this class of cases, from distinct etiological roots. Elsewhere, with reference to other types, as we saw, she finds epilepsy to impair the mind. In any event, while the two pathological conditions, in their processes and manifestations, may have more or less in common, while mental feebleness may even "predispose" toward epilepsy or share with it identical etiological conditions, since the one disease can occur without the other, their conjunction, as we pointed out, must be partly fortuitous, that is, it must represent the coming together of causal processes for reasons at present unknown to us.

The results obtained by Dr. Cleaves accord with the findings of other investigators, especially those who have examined the family history of epileptics. For instance:[1] "The association of the defective mind with epilepsy is indicated by the charts which show the normal, diseased and defective representations of the family stock, and reveal some of the ways in which degeneration of germ plasm may manifest itself. The fact that so many of the immediate relatives of this one small group of epileptics are feebleminded is suggestive and makes it clear that epilepsy and feeblemindedness must be studied together. In the first group of nine cases, the social standing of the families studied was low, as might be expected from the fact that the patients were public charges."[2] A second group of nineteen cases "also public charges" and whose histories "in general.....resemble those of the first" (group), was studied later, and furnishes the basis for the statistical data which follows. "Epilepsy shows itself in the family histories of eleven out of the nineteen cases, a total of thirty-four times. Feeblemindedness shows itself in thirteen cases, a total of one hundred thirty-seven times. Divorce, desertion and nonsupport are present in thirteen cases and appear in all fifty-seven times. Criminality appears in six cases, a total of twenty-one times. Alcoholism appears in fourteen cases, in all seventy-four times. Insanity is present in seven cases, a total of twenty-one times; suicide in four cases, a total of nine times; eccentricity in six cases, a total of eleven times. Temper appears in nine cases, a total of thirty-two times; drug habits in three cases, a total of five times; migraine in five cases, a total of eleven times. Tuberculosis appears in nine cases, a total of fifteen times; syphilis in three cases, a total of six times; goitre in seven cases, a total of seventeen times. Cancer shows itself in four cases, a total of twenty-five times; strabismus in seven cases, a total of fourteen times; speech defect in eight cases, a total of twenty-nine times; deformities in four cases, in all nine times; and dwarfism and acromegaly in five cases, a total of nine times."

Evidence obtained from a study of cases of this subnormal type forms the basis, as has been shown, for nearly all our knowledge of epilepsy. Recent investigations into the heredity

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[1]Nineteen Epileptic Families: A Study," *State of New York, State Board of Charities, Eugenics and Social Welfare Bulletin*, No. 9, 1917, pp. 5-7.

[2]This illustrates our "Select Group" theory.

of epileptics, carried on by careful researchists,[1] were thus inductively restricted, as will be observed by referring to the charts which embody the results of their studies. Mrs. Ferrero,[2] daughter of the celebrated criminologist Lombroso, in explication of her father's point of view is constrained to these statements: "The connection between epilepsy and crime is one of derivation rather than indentity. Epilepsy represents the germs of which criminality and moral insanity are the species,..... The born criminal is an epileptic, not however, afflicted with the common form of the disease, but with a special kind. The pathological basis, the etiology, and the anatomical and psychological characteristics are identical, but there are many differences, ... We have therefore, an epilepsy sui generis, a variety of epilepsy which may be called criminal. Thus the primitive idea of crime has become organic and complete. The criminal is only a diseased person, an epileptic in whom the cerebral malady, begun in some cases during prenatal existence, or later in consequence of some infection, or cerebral poisoning, produces, together with certain signs of physical degeneration, in the skull, facies, teeth and brain, a return to the early brutal egotism natural to primitive races, which manifests itself in homicide, theft and other crime." It is patent that Lombroso has founded his studies upon a limited induction. Nor would his thesis as to the etiological function of epilepsy in the production of crime find acceptance with the majority of contemporary investigators. Those, on the other hand, would seem to be nearer the truth who find epilepsy as intimately allied to the higher types of mind. Conklin[3] says, for example: "It frequently happens that families in which hereditary insanity occurs also have other members afflicted with epilepsy, hysteria, alcoholism, etc., which would indicate that the thing inherited is an unstable condition of the nervous system which may take various forms under slightly different conditions. .....There is a good deal of evidence that extraordinary ability, or genius, is frequently associated with an unstable nervous organization

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[1]Charles B. Davenport, "*Heredity in Relation to Eugenics*," Henry Holt & Co., 1911, pp. 72-76.

[1]Charles B. Davenport and David F. Weeks, "A First Study in Inheritance in Epilepsy," *Eugenics Record Office Bull.*, No. 4.

[1]Charles B. Davenport, "Heredity of Constitutional Mental Disorders," *Eugenics Record Office, Bull.*, No. 20.

[2]Gina Lombrosso Ferrero, "*Criminal Man according to the classification of Cesare Lombroso*," G. P. Putnam's Sons, New York, 1911, pp. 69-73.

[3]Edwin C. Conklin, "*Heredity and Environment*," Princeton University Press, 3d Edition, 1919, p. 71.

which may sometimes take the form of insanity or epilepsy or alcoholism." Whatever may be the truth in regard to the assumed instability of the neural organization, it is clear that studies limited in most part to institutional patients have, until recently, given to investigators a somewhat too pessimistic picture of the epileptic mentality, and that a broader induction will avail to correct this impression.

In addition to researches restricted, even to the present day, almost entirely to institutional, i. e. selected material, there are other factors which have tended to identify, ipso facto, the processes of epilepsy, whether causal or resultant, with those of the congenital inferiorities and authenic deteriorations of personality. These are the "secondary" or extraneous factors previously alluded to.[1]

Though perhaps not primary in importance, we would name,

I. Mental and Intellectual Desuetude. Epileptic patients are, as a rule, warned against strenuous mental exertion, and, particularly, all higher intellectual endeavor because of its supposed adverse effect upon the disease. As a result of the admonition, individuals who possess capability for a high degree of mental accomplishment are denied opportunity therefor, with the inevitable result that these unused abilities undergo a rapid decline. This effect is enhanced by the baneful influence upon the subject of chance remarks that he may hear, or occasional articles that he may read, which convey the impression that epilepsy is a progressive disease, exercising a gradually deteriorating influence upon the brain and terminating in complete imbecility. The natural subjective effect of such a suggestion is one of mental and intellectual self-depreciation, which, in turn, acts as a powerful deterrent to the putting forth of any effort in this field of endeavor.

II. Unfavorable and depressing social and environmental conditions which are an unavoidable consequence of the disease. The fact that an individual is subject to attacks of epilepsy, that at any moment he may suffer a temporary impairment or complete loss of consciousness, which may be accompanied by violent convulsions, renders it necessary, if he would be protected from bodily injury during these periods of utter helplessness, that he order his daily life with the purpose in view of avoiding, as far as possible, all exposure to danger from this source. His entire habit of life, therefore, must be changed to meet this new requirement. Business,

[1]pp. 22 and 23.

social intercourse, activities and pleasure of nearly every type, must be curtailed or wholly abandoned. The individual, if he lives at home, is confined more or less closely to the house, and whenever he goes for a walk it must be in company with a friend or an attendant. By reason of the very nature of his affliction, the danger to which it exposes him, and the repugnance which it arouses toward him in other persons, such an individual is denied intimate contact with the world at large, and he must live therefore, to a certain degree a "hermit life." In many cases the afflicted person cannot, because of financial or other reasons be given the proper care and attention at home, and he is, therefore, committed to an institution. He is now in a little domain entirely isolated from the outside world; his associates are, for the most part, those of like infirmity with himself; he becomes a frequent witness of epileptic manifestations in their various phases,—acute attacks, dementia, mania, as it is revealed by those about him. In the light of these facts, therefore, can it be matter of surprise that the epileptic, whether at home or in an institution, should manifest to a greater or less extent in his own personality the stultifying effect of the adverse conditions to which he is necessarily subjected by reason of his affliction? As his vision becomes gradually more and more narrowed, so likewise does his interest; his attention shows a tendency to turn inward upon himself rather than outward upon the world at large; he becomes, by reason of this fact, supersensitive and emotionally impoverished, developing, in other words, the so-called "epileptic personality."

III. Methods of Treatment which have for their purpose the control of epileptic seizures, but which in the achievement of this result, exercise a pernicious effect upon the central nervous system. We refer, particularly, to the drug treatment of epilepsy, through the use of bromides and other powerful sedatives. It is self-evident that if these drugs are to accomplish their desired effect they must be administered in quantities sufficient to render the cortical centres immune to stimuli which might induce an epileptic attack, and an inevitable consequence is an inhibition of all the higher mental and intellectual processes. The long-continued use of such measures, in the case, at least, of the bromides, produces a cumulative effect which serves as an effectual hindrance to all but the very simplest type of mental activity. To facilitate a clearer understanding of these facts we will cite the comments of various writers relative to the use of bromides in epilepsy and their effect upon the mental constitution of the patient:

"....There are epileptics who seem to manifest almost

no mentality; not because it has been lost, but because of its subversion through powerful bromide drugging that has gone on uninterruptedly for years."

[2]"Blunting of the intellectual faculties is a notable result of the bromides, and is first shown in loss of memory. I formerly thought this condition was due to the seizures, but witnessing the complete restoration of memory in so many cases after the bromides had for some time been withdrawn, there was no alternative but to ascribe it to the use of the drug,.... They," i. e. the bromides, "produce.....forgetfulness and slight degrees of aphasia usually shown in the misuse of words and the wrong formation of sentences."

[3]"The theory of their use," i. e. of bromides, "and that of other sedatives is based upon the fact that they act on the cells of the central nervous system which is presumably the point of origin of the convulsion, stupifying them and thus preventing and reducing the number of seizures. Most of the modern authorities consider the bromide treatment as palliative rather than curative and agree that it should be used only guardedly on account of its disastrous effects. Peterson[4] is of the opinion that bromides have on the whole been more injurious than beneficial. [5]"Anyone who has observed a number of cases in which an attempted control has been made with the bromides, either alone, or combined with chloral hydrate, is aware that the temporary beneficial results are more than offset by the resulting languid, drowsy, stuporous condition of the patient, his impaired mentality and the hastening of his terminal dementia."

IV. Changes, more or less pronounced, in personality and mental acuity, which may occur during a varying interval of time either prior to or subsequent to the acute attacks, or which may, at times, replace the convulsive phenomena (psychic

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[1]William P. Spratling, "Guides to the Prognosis in Epilepsy, with Remarks on the Curability of the Disease; Including Reports of 34 cases," *New York Medical Journal and Philadelphia Medical Journal, consolidated*, April 9 and 16, 1904, p. 737.

[2]William P. Spratling, "The Abuse of Bromides in Epilepsy," *Medical Record*, September 2, 1905, p. 377.

[3]"Nine Family Histories of Epileptics in One Rural County," *State of New York State Board of Charities, Eugenics and Social Welfare Bull.*, No. 7, 1916, p. 33.

[4]Frederick Peterson, "The Bromides in Epilepsy," *Philadelphia Am. Med.*, 1905, IX, p. 1019.

[5]Victor R. Small, "Drug Therapy in Epilepsy," *Virginia M. Month.*, Richmond, 1921-22, XLVIII, p. 388.

equivalents). These changes, to which Turner[1] gives the name "paroxysmal psychoses," have been described by [2]Yawger as follows: "Preparoxysmal manifestations are known as prodromes, and they consist for the most part of irritability, excitability, depression, unusual slowness of cerebration, insomnia, a feeling of unreality, and occasionally hallucinations; these manifestations may occur hours or even days before the attack; ..... An epileptic psychosis most commonly succeeds the convulsion, and it usually lasts but a few hours, although in rare instances it may extend over a period of weeks. The milder manifestations are for the most part delirium, stupor or confusion,....."

It is unnecessary to observe, in this connection, that each of the "secondary" or extraneous factors here enumerated cannot be found in every instance. Doubtless many or all are present in some cases, while absent in others. Epileptic institutions throughout the country are performing a much-needed and beneficent task in granting their inmates a life free from many adverse environmental conditions. But they are powerless, in the nature of the case, to remove the effects of bad heredity and other untoward circumstances to which numbers of patients, in some instances for a long term of years, have been exposed before their admittance to institutional care. In addition, there are factors of environment inseparable from the institution as such and, under the best auspices, effective in their degree upon the life of the patient; withdrawal from the world at large with its healthful activities, social intercourse with sufferers of one's own type, the frequent witnessing of convulsions, etc. Wherefore, it is essential, because of the diversification of conditions prior to institutional admittance and often, in view of the need of the individual, subsequent thereto, that each subject be regarded as a peculiar and distinct unit the result of whose test shall be interpreted in the light of his personal and his family past.

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[1]Wm. A. Turner, "*Epilepsy*," MacMillan & Co., 1907, p. 108

[2]N. S. Yawger, "The Mental Manifestation of Epilepsy," *J. Abnor. Psychol.*, Boston, 1912-13, 7, p. 426.

SUMMARY

1. Of single mental tests, the one that is perhaps, of greatest diagnostic value, and at the same time, is easiest of application to epileptic subjects is the Auditory Memory Span Test. The more complicated Intelligence and Performance Tests are, for various reasons, unsuited to this purpose.

2. The Auditory Memory Span Test is a test not of memory, as the name would seem to imply, but of associability, the determination of which serves as an index of the general mental calibre of the subject.

3. This test was applied, by the writer to 2000 inmates,—of both sexes and of ages 5-50, of four institutions for epileptics located in three states. The results obtained were correlated with the standardized results of Humpstone for normal individuals, which correlation, in turn, is embodied in the statistical tables of this study, and forms the basis of their subsequent discussion and interpretation.

4. General conclusions to be deduced from the statistical evidence presented herewith are as follows:

    1. The epileptic, both the child and the adult has a Memory Span only approximately one-half that of the normal individual. A considerable proportion of the epileptics belong to the feebleminded group, and but one-fifth of the total number are capable of any but the simplest mental activity. Of this latter group only a few are mentally qualified for higher intellectual pursuits.

    2. The epileptic adult shows a relatively far higher degree of associability than the epileptic child, and he is, therefore, far more capable of mental endeavor. The epileptic adult, furthermore, rates higher mentally in relation to the normal individual than does the epileptic child. This disparity in the relative mental ability of the epileptic adult and child increases slowly but directly with the age of the former. These facts would seem to be at variance with the traditional and almost universally accepted theory of progressive mental deterioration in epilepsy.

5. Epilepsy and mental enfeeblement may occur in association with, or independently of each other. There is but

one adequate explanation, viz: the two conditions are the result of either:

1. Distinct etiological factors acting in unison or independently of each other.
2. A common factor.

6. The results of mental tests are of little value in determining the relative mental rating of an individual except as they are studied in conjunction with his personal and family history. The latter may reveal the existence of various secondary or extraneous factors which are, in themselves, fully competent to explain these results, and which may be enumerated as follows:

   1. Unfavorable heredity.
   2. Mental and Intellectual Desuetude.
   3. Adverse and depressing social and environmental conditions consequent upon the disease.
   4. Methods of treatment having for their purpose the prevention of the epileptic seizure, but exercising therewith a pernicious effect upon the central nervous system.
   5. More or less pronounced changes in personality and mental acuity, which occur within an indefinite interval of time either prior or subsequent to the acute attacks, or which replace, on occasion, the convulsive phenomena (psychic equivalents).

(APPENDIX)
Tables of Humpstone

Table I. Memory Span of Normal Persons For Different Ages by Quintiles

Age	No. of Cases	Mean	M. V.	Minimum	Lowest Quintile	Lower Quintile	Median	Upper Quintile	Highest Quintile	Maximum
5	5	3.8	0.32	3	4	4	4	4	4	4
6	104	4.3	0.50	3	4	4	4	4	5	6
7	248	4.7	0.73	3	4	4	5	5	5	7
8	300	5.2	0.86	3	4	5	5	5	6	8
9	288	5.3	0.90	3	4	5	5	5	6	9
10	316	5.7	1.00	4	5	5	6	6	7	9
11	329	5.9	0.92	4	5	6	6	6	7	9
12	404	6.1	0.93	4	5	6	6	6	7	9
13	437	6.5	1.07	4	5	6	7	7	8	10
14	316	6.5	1.08	4	5	6	7	7	8	10
15	167	6.8	1.08	4	5	6	7	7	8	11
16	89	7.0	0.91	4	6	7	7	7	8	10
17	35	6.4	0.86	4	5	6	7	7	7	8
18+	24	6.8	0.98	4	5	7	7	8	8	10
Adult	237	8.1	1.28	5	7	7	8	9	10	12

Table II. Distribution of Results From Elementary School Boys

Age	No. of Cases	3	4	5	6	7	8	9	10	Mean	Mode	Median	M.V.
5	1		1										
6	43		28	15						4.3	4	4	0.44
7	138	3	65	49	13	8				4.7	4	5	0.73
8	161	1	51	61	30	14	4			5.1	5	5	0.80
9	139	2	32	57	29	18	1			5.2	5	5	0.81
10	162		27	52	41	34	7	1		5.6	5	6	0.98
11	158		13	39	48	44	10	4		6.1	6	6	0.92
12	209		12	59	64	52	21	1		6.1	6	6	0.89
13	210		2	50	46	67	29	15	1	6.6	7	7	1.46
14	132		5	28	31	40	18	8	2	6.5	7	7	1.10
15	43		2	8	8	21	2	1	1	6.5	7	7	0.94
16	13		1	4	1	3	2	2		6.5	5	7	1.42
T'ls	1409	6	239	422	311	301	94	32	4	5.8	5	6	1.09

Table III. Distribution of Results From Elementary School Girls

Age	No. of Cases	3	4	5	6	7	8	9	10	Mean	Mode	Median	M.V.
5	4	1	3							3.8	4	4	0.35
6	61	3	37	18	3					4.3	4	4	0.54
7	110	3	45	44	12	6				4.8	4	5	0.71
8	139	1	39	47	32	18	2			5.2	5	5	0.88
9	149		34	53	30	25	6	1		5.5	5	5	1.00
10	154		25	43	39	36	9	2		5.8	5	6	1.02
11	171		13	63	46	34	15			5.9	5	6	0.91
12	195		13	54	56	45	22	5		6.1	6	6	0.97
13	221		7	58	46	71	24	15		6.4	7	6	1.69
14	142		4	37	33	44	11	10	3	6.4	7	6	1.94
15	49		1	15	9	17	3		4	6.4	7	6	1.15
16	9				5	2		1	1	7.0	6	6	1.11
17	1			1									
T'ls	1405	8	221	433	311	298	92	34	8	5.8	5	6	1.09

Table IV. Table I and II Combined With the Addition of 248 Boys From the Trades School

Ags	No. of Cases	3	4	5	6	7	8	9	10	11	Mean	Mode	Median	M.V.
5	5	1	4								3.8	4	4	0.32
6	104	3	65	33	3						4.3	4	4	0.50
7	248	6	110	93	25	14					4.7	4	5	0.73
8	300	2	90	108	62	32	6				5.2	5	5	0.86
9	288	2	66	110	59	43	7	1			5.3	5	5	0.90
10	316		52	95	80	70	16	3			5.7	5	6	1.00
11	329		26	102	94	78	25	4			5.9	5	6	0.92
12	404		25	113	120	97	43	6			6.1	6	6	0.93
13	437		9	108	93	140	54	32	1		6.5	7	7	1.07
14	316		9	70	73	99	39	21	5		6.5	7	7	1.08
15	167		3	34	29	62	21	9	7	2	6.8	7	7	1.08
16	89		1	11	16	35	14	10	2		7.0	7	7	0.91
17	35		1	7	6	18	3				6.4	7	7	0.86
18+	24		1	4	3	10	5		1		6.8	7	7	0.98
T'ls	3062	14	462	888	663	698	233	86	16	2	5.9	5	6	1.10

Table V. Distribution of Results From Two Successive Classes in Psychology 1 at the University of Pennsylvania

	No. of Cases	5	6	7	8	9	10	11	12	Mean	Mode	Me-dian	M.V
Men	116	6	9	31	22	23	16	8	1	8.1	7	8	1.31
Women	121	5	9	36	23	22	20	6		8.1	7	8	1.25
Both	237	11	18	67	45	45	36	14	1	8.1	7	8	1.28